

Estimates of the Direct and Indirect Costs of Acquired Immunodeficiency Syndrome in the United States, 1985, 1986, and 1991

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Synopsis

This study presents three estimates—ranging from low to high—of the direct and indirect costs of the AIDS epidemic in the United States in 1985, 1986, and 1991, based on prevalence estimates provided by the Centers for Disease Control

(CDC). According to what the authors consider their best estimates, personal medical care costs of AIDS in current dollars will rise from \$630 million in 1985 to \$1.1 billion in 1986 to \$8.5 billion in 1991. Nonpersonal costs (for research, screening, education, and general support services) are estimated to rise from \$319 million in 1985 to \$542 million in 1986 to \$2.3 billion in 1991. Indirect costs attributable to loss of productivity resulting from morbidity and premature mortality are estimated to rise from \$3.9 billion in 1985 to \$7.0 billion in 1986 to \$55.6 billion in 1991.

While estimated personal medical care costs of AIDS represent only 0.2 percent in 1985 and 0.3 percent in 1986 of estimated total personal health care expenditures for the U.S. population, they represent 1.4 percent of estimated personal health care expenditures in 1991. Similarly, while estimated indirect costs of AIDS represent 1.2 percent in 1985 and 2.1 percent in 1986 of the estimated indirect costs of all illness, they are estimated to rise to almost 12 percent in 1991.

Estimates of personal medical care costs were based on data from various sources around the United States concerning average number of hospitalizations per year, average length of hospital stay, average charge per hospital day, and average outpatient charges of persons with AIDS. For estimating the indirect costs the human capital method was used, and it was assumed that average wages and labor force participation rates of persons with AIDS were the same as those for the general population by age and sex.

THE FINANCIAL BURDEN WHICH THE AIDS epidemic in the United States imposes on its victims, on society in general and, in particular, on the metropolitan centers where the disease is concentrated has caused widespread concern. Despite this general concern, however, data on use of and expenditures for medical services of persons with AIDS are surprisingly scarce and very limited. Similarly, data on nonpersonal medical costs—such as expenses for research, blood screening and testing, replacement of blood, health education, and support services—are equally difficult to ob-

tain. Finally, to date only one estimate has been made of the indirect costs of AIDS, that is, the losses incurred by AIDS patients due to time lost from work because of illness, disability, and premature death.

The most frequently cited AIDS cost figure in the United States is an estimate of the lifetime hospital costs and economic losses from disability and premature death (indirect costs) of the first 10,000 patients with AIDS reported in the United States. These estimates were made by Ann Hardy of the national Centers for Disease Control (CDC)

Table 1. Estimate of prevalence of AIDS, United States: reported cases for 1984 and estimates for 1985, 1986, and 1991

Prevalence categories	Reported cases 1984	Estimates		
		1985	1986	1991
AIDS patients alive all 12 months but diagnosed prior to year	1,424	3,360	6,240	42,000
AIDS patients who died during year	3,534	6,240	10,800	64,800
AIDS patients diagnosed during year and alive at end of year	4,410	9,120	14,400	66,000
Prevalence (cases)	9,368	18,720	31,440	172,800
Prevalence rate (cases per 100,000 population)	3.96	7.84	13.05	68.63
Death rate (cases per 100,000 population)	1.49	2.61	4.48	25.74

SOURCE: W. Meade Morgan, PhD, Chief of Statistics and Data Processing Branch, AIDS Program, CDC.

At Dr. Morgan's suggestion, the estimates he provided have been increased by 20 percent to take account of underreporting.

'Because of the large increase in the total number of AIDS cases, however, the death rate from AIDS is estimated to rise from 1.49 deaths per 100,000 population in 1984 to 25.74 deaths per 100,000 in 1991.'

and her colleagues and first presented at a conference on AIDS in Atlanta, GA, in April 1985 (1). They estimated lifetime hospital costs of these patients at \$1.473 billion, or \$147,000 per AIDS patient. This estimate was based on the assumption of a lifetime use of 168 hospital days, an average survival time of 392 days (or about 13 months), and an average charge (including inpatient professional charges) per hospital day of \$878 (based on charges for 35 AIDS patients hospitalized at one acute care hospital in Atlanta). They stressed that "These figures are admittedly estimates . . . since data were available from only a few sources." In the same article, the lifetime indirect costs of these 10,000 cases were estimated at \$4.8 billion, almost 3½ times direct hospital costs.

Even today, more than a year after these early estimates, data for estimating the economic costs of the AIDS epidemic in the United States are scarce. Apart from a study of the lifetime medical care costs of AIDS patients in California, based on MediCal (Medicaid) claims data (2), there have been no systematic studies. However, additional data on the use and costs of medical services of AIDS patients can be found in unpublished reports by State and city health departments (for example, New York, California, New York City) and by a few hospital associations (for example, Greater

New York Hospital Association, New York City Health and Hospitals Corporation, Hospital Council of Southern California, West Bay Hospital Conference). In addition, some hospitals have compiled data on average length of hospital stay and costs or charges per hospital day of AIDS admissions.

In late 1985, the CDC asked us to make new estimates of the direct and indirect economic costs of AIDS in the United States. Our report to the CDC was completed in March 1986 (3), but we have since revised our estimates upward to take account of more recent higher CDC estimates of the incidence and prevalence of AIDS (4,5). The prevalence estimates we used were prepared by W. Meade Morgan, PhD, Chief of Statistics and Data Processing Branch, AIDS Program, CDC. At our request (because for our estimates we needed the data in this form), he classified all reported AIDS patients alive at any time in 1984, and the estimated number of such persons in the later years, into the following three prevalence categories:

- those diagnosed in a prior year and alive all 12 months,
- those who died in the year, and
- those newly diagnosed and alive at the end of the year.

For 1984, Morgan also distributed the patients in each of these three categories into three broad diagnostic groups and classified them by age and sex within each diagnostic group. The three diagnostic groups are *Pneumocystis carinii* pneumonia and other infectious diseases, Kaposi's sarcoma, and all other conditions. The year 1984 was selected because it was the first year that health departments in the United States confirmed all cases using the strict definition of AIDS specified

Table 2. Estimated economic costs of AIDS: amount and percent distribution of medium estimates by type of cost for 1985, 1986, and 1991

Year	Total direct and indirect costs	Direct costs			Indirect costs		
		Total	Personal medical costs	Non-personal costs	Total	Morbidity costs	Mortality costs ¹
<i>Millions of current dollars</i>							
1985	\$4,836	\$949	\$630	\$319	\$3,887	\$261	\$3,626
1986	8,674	1,662	1,119	542	7,012	456	6,556
1991	66,464	10,869	8,544	2,325	55,595	3,315	52,280
<i>Percent of total direct and indirect costs</i>							
1985	100.0	19.6	13.0	6.6	80.4	5.4	75.0
1986	100.0	19.2	12.9	6.3	80.8	5.3	75.6
1991	100.0	16.4	12.9	3.5	83.6	5.0	78.7

¹4 percent discount rate.

by the CDC. In addition, 1984 data are complete and there are no reporting lags as there would have been had we used 1985 data. For the later years, Morgan suggested we assume that the distribution of patients within each of the three prevalence categories by diagnosis, age, and sex was the same as in 1984, since there was no adequate basis for forecasting these distributions more accurately. Finally, he advised us to increase all his estimates by 20 percent to correct for underreporting of AIDS cases.

Summary of Findings

Table 1 shows the prevalence estimates prepared by Morgan increased by 20 percent for our estimates to take account of underreporting. The total number of persons with AIDS alive at any time during the year is estimated to rise from 9,368 in 1984 to 18,720 in 1985, to 31,440 in 1986, and to 172,800 in 1991. This represents an increase in the prevalence rate from 3.96 cases per 100,000 population in 1984 to 68.63 cases per 100,000 population in 1991. Morgan estimates that the percentage of those alive all 12 months of the year will increase from about 15 percent of all those with AIDS in 1984 to 24 percent in 1991, the percentage of those newly diagnosed and alive at the end of the year will decline from 47 percent in 1984 to 38 percent in 1991, and the percentage of those who died will remain relatively stable, ranging between 33 percent and about 38 percent of all those with AIDS. Because of the large increase in the total number of AIDS cases, however, the death rate from AIDS is estimated to rise from 1.49 deaths per 100,000 population in 1984 to 25.74 deaths per 100,000 in 1991.

The following costs were estimated:

Direct costs:

- Personal medical care costs; these include expenditures for hospital services, physician inpatient and outpatient services, outpatient ancillary services, and nursing home, home care, and hospice services.
- Nonpersonal costs; these include expenditures for research, blood screening and testing, replacement of blood, health education, and support services.

Indirect costs:

- Morbidity costs; these are the value of productivity losses due to illness and disability.
- Mortality costs; these are the present value of future earnings lost for those who died prematurely as a result of AIDS.

No attempt was made to estimate the dollar value of social support services and public health information provided by volunteers, although there is evidence that community-based organizations providing such services rely heavily on volunteer labor (6). Nor did we attempt to estimate the psychological costs due to AIDS even though it is recognized that these are real and great for the AIDS victims and their families.

All estimates were made in 1984 dollars which have been converted to current dollars in table 2. For 1985, our estimate of the total direct and indirect costs of AIDS comes to about \$4.8 billion, of which \$630 million are for personal medical care costs, \$319 million for nonpersonal direct costs, and \$3.9 billion for indirect costs. The corresponding figures for 1986 are a total of \$8.7 billion, of which \$1.1 billion are for personal

Table 3. Average number of hospital admissions, of hospital days per admission, average charge per hospital day, and average outpatient charges by prevalence category and initial diagnosis for AIDS patients receiving all inpatient and outpatient care at San Francisco General Hospital in 1984

Cost variables	<i>Pneumocystis carinii</i> pneumonia and other infectious diseases	Kaposi's sarcoma	All other conditions ¹
AIDS patients alive all 12 months but diagnosed prior to 1984 (N = 30):			
Average number of admissions per patient.....	1.50	.42	.42
Average number of hospital days per admission.....	11.89	3.70	3.70
Average charge per hospital day.....	\$683	\$785	\$785
Average outpatient charges per patient.....	\$3,222	\$3,721	\$3,721
AIDS patients who died during 1984 (N = 83):			
Average number of admissions per patient.....	2.49	2.56	2.56
Average number of hospital days per admission.....	11.38	8.46	8.46
Average charge per hospital day.....	\$843	\$789	\$789
Average outpatient charges per patient.....	\$1,636	\$2,942	\$2,942
AIDS patients diagnosed during 1984 and alive at end of 1984 (N = 88):			
Average number of admissions per patient.....	1.62	.45	.45
Average number of hospital days per admission.....	16.63	11.19	11.19
Average charge per hospital day.....	\$665	\$700	\$700
Average outpatient charges per patient.....	\$1,559	\$2,124	\$2,124

¹All other conditions assumed to be like Kaposi's sarcoma.

medical care costs, \$542 million for nonpersonal direct costs, and \$7.0 billion for indirect costs. In 1991, they are estimated to rise to a total of \$66.5 billion, of which \$8.5 billion are for personal medical care expenses, \$2.3 billion for nonpersonal direct costs, and almost \$56 billion for indirect costs. Thus in all 3 years, indirect costs due to morbidity, and especially premature mortality, account for about 80 to 84 percent of the total economic cost of the AIDS epidemic. The reason for the high indirect costs, and especially the high mortality costs, is the fact that most of the victims of AIDS are young, in the 20- to 40-year age bracket, and thus in their most productive years. Although the direct medical care costs of AIDS are not negligible, they are far surpassed by the indirect costs due to premature mortality.

The detailed estimates and the methods of arriving at them are described in the following sections.

Estimates of Personal Medical Care Costs

We based our model for estimating the direct personal medical care costs of AIDS patients in the United States on information we gained from a retrospective study of medical care costs of AIDS patients treated at San Francisco General Hospital (SFGH) in 1984 (7). In 1984, San Francisco ranked second after New York in the number of AIDS cases in the United States, and about one-half of all San Francisco persons with AIDS were treated at SFGH.

Our study yielded data on three types of AIDS patients:

- all AIDS admissions to SFGH in 1984, by diagnosis (N = 445)
- AIDS patients who received all their hospital and inpatient and outpatient professional services at SFGH in 1984 (N = 201)
- AIDS patients who died in 1984 and who had all their hospital and inpatient professional services from diagnosis to death at SFGH (N = 85)

It is the information gained from the second group, those who received all their inpatient and outpatient care at SFGH, which we used in constructing our model. Our data for these patients showed that they fell into the three distinctive prevalence categories described previously, based on their monthly medical expenses. These expenses were lowest (\$586) for patients who lived all 12 months; highest (\$3,660) for those who died and who, on the average, had expenses for 6.4 months of the year; and in between the two (\$2,617) for those who were newly diagnosed and alive at the end of the year who, on the average, had expenses for 4.6 months. In addition, we found that patients with different initial diagnoses incurred different costs and that, as a result, we had to distinguish among at least the three diagnostic groups (also described previously) within each of the three prevalence categories. Our data showed that patients with *Pneumocystis carinii* pneumonia and other infectious diseases were

considerably more expensive to treat than those with Kaposi's sarcoma, who can be treated to quite an extent on an outpatient basis. Data on hospital charges for patients with conditions other than *Pneumocystis carinii* pneumonia, other infectious diseases, and Kaposi's sarcoma suggested that these patients were somewhat less costly to treat than those with Kaposi's sarcoma, although the difference was not substantial.

On the basis of this information, we constructed a simple model to estimate the personal medical care costs of AIDS patients in a given year where the variables determining expenses per case of AIDS were the average number of hospital admissions per case, the average number of hospital days per admission, the average charge per hospital day, and average outpatient charges per case. Total expenses for a given year (for example, 1985) then are:

$$Cost_{1985} = N_{1985} \times [(a \times b \times c) + d]$$

where

N = total number of AIDS patients alive at any time during the year

a = average number of admissions per case

b = average number of hospital days per admission

c = average charge per hospital day

d = average outpatient charges per case

The average number of admissions per case is the total number of admissions in the year divided by the total number of AIDS cases alive at any time during the year. Similarly, average outpatient charges are total outpatient charges during the year divided by the total number of AIDS patients alive at any time during the year.

As a first step, we used our 1984 SFGH data on these four variables for each of the nine prevalence and diagnosis-specific groups, shown in table 3, and the CDC's distribution of the 1984 cases in the United States among the nine groups, shown in table 4, to calculate averages for the four variables for the United States as a whole. Because we had only one case with a condition other than *Pneumocystis carinii* pneumonia, other infectious diseases, and Kaposi's sarcoma in the group of patients who received all their inpatient and outpatient care at SFGH in 1984, we assumed costs of these other cases to be similar to those of patients with Kaposi's sarcoma, although data on 177 hospital admissions of such cases suggest that they may be slightly less expensive to treat. Because the estimated distribution of AIDS patients among the

Table 4. Distribution of AIDS patients by prevalence category and initial diagnosis, United States, 1984

Prevalence category and diagnostic groups	Number of cases	Percent of all patients	Percent of prevalence category
All AIDS patients ..	9,368	100.0	...
AIDS patients alive all 12 months but diagnosed prior to 1984.....	1,544	16.5	100.0
<i>Pneumocystis carinii</i> pneumonia and other infectious diseases ...	1,002	10.7	64.9
Kaposi's sarcoma	520	5.6	33.7
All other conditions	22	.2	1.4
AIDS patients who died during 1984.....	3,414	36.4	100.0
<i>Pneumocystis carinii</i> pneumonia and other infectious diseases ...	3,018	32.2	88.4
Kaposi's sarcoma	372	4.0	10.9
All other conditions	24	.3	.7
AIDS patients diagnosed during 1984 and alive at end of 1984	4,410	47.1	100.0
<i>Pneumocystis carinii</i> pneumonia and other infectious diseases ...	3,493	37.3	79.2
Kaposi's sarcoma	882	9.4	20.0
All other conditions	35	.4	.8

SOURCE: W. Meade Morgan, PhD, Chief of Statistics and Data Processing Branch, AIDS Program, CDC. At Dr. Morgan's suggestion, the estimates provided by him have been increased by 20 percent to take account of underreporting.

three prevalence categories in 1985 and 1986 differs slightly, and in 1991 differs considerably from that in 1984, we repeated these calculations for the later years as well. However, the averages resulting from these calculations were so similar that we used those based on the 1984 distribution of cases. These figures are shown in column 1 of table 5. The calculations of averages for the four cost variables in our model were necessary because most of the other data on these variables refer to all AIDS patients and are not prevalence category- and diagnosis-specific.

Using this formula, we made three estimates of the personal medical care costs of AIDS for each of the 3 years, ranging from low to high, varying the cost variables on the basis of data from various sources. All estimates are in 1984 dollars. The assumptions for the three estimates are shown in columns 2 through 4 of table 5. Table 6 shows the results of these estimates. For 1985 they range from \$381 million to \$597 million to just over \$1 billion. For 1986 they range from \$640 million to somewhat more than \$1 billion to \$1.7 billion. Finally, for 1991 they range from \$3.5 billion to \$5.5 billion to \$9.4 billion.

Table 5. Model for estimating the personal medical care costs of AIDS in the United States

Cost variables	Averages for 1984 based on SFGH data and U.S. distribution of cases	Low estimate	Medium estimate	High estimate
	1	2	3	4
Average number of hospital admissions per patient	1.7	1.7	1.7	2.2
Average number of hospital days per admission	13	13	20	25
Average charge per hospital day	\$740	\$740	\$850	\$950
Average outpatient charges per patient	\$2,000	\$4,000	\$3,000	\$2,000

NOTE: SFGH = San Francisco General Hospital.

'The reason for the high indirect costs, and especially the high mortality costs, is the fact that most of the victims of AIDS are young, in the 20- to 40-year age bracket, and thus in their most productive years. Although the direct medical care costs of AIDS are not negligible, they are far surpassed by the indirect costs due to premature mortality.'

The low estimates are based on the data derived from our SFGH study, shown in column 1 of table 5, except that we have increased average outpatient charges to \$4,000. We made this adjustment to take account of nonhospital outpatient charges (mainly home health and hospice care) which we estimated on the basis of expenditures of one of the San Francisco voluntary agencies providing home health and hospice care to AIDS patients.

We regard these low estimates as the very lowest possible estimates because they are derived from data from SFGH. Data from other areas suggest that costs of treating AIDS patients in San Francisco are considerably lower than elsewhere, primarily because of a very much shorter hospital stay. Thus these low estimates can be regarded as estimates of personal medical care costs of AIDS patients if the special conditions existing in San Francisco prevailed elsewhere.

For the other estimates, we made use of data from our review of all other sources which we were able to obtain. These are summarized in table 7 and are reviewed briefly in the following sections.

Data on average number of admissions per case. Data on this variable are extremely scarce. A study

by Seage and co-workers, conducted in Massachusetts, very similar to our study of AIDS patients who received all their inpatient and outpatient care at SFGH in 1984, evaluated the use and costs of medical services of 45 AIDS patients over a 12-month period (table 7, item 19). This study showed 1.6 hospitalizations per patient during this period, very close to our 1.7 for the United States, based on the SFGH data. A few other estimates, also covering patients over the course of a year but for varying lengths of time, also suggest that 1.7 admissions is a reasonable average to assume (table 7, items 4, 8, 14). The State of California AIDS data (table 7, item 1) imply 4.3 hospital episodes over a 12-month period. Our estimate of 1.7 hospitalizations per person alive at any time during the year translates into 3.2 admissions *per person year*. In the absence of any data, we have used 1.7 admissions per case for our medium estimates and 2.2 for our high estimates, a 30 percent increase which brings it close to the rate shown by the State of California data.

Average length of hospital stay. Data on average length of hospital stay range all the way from 10.8 to 72.2 days. However, the stays appear to be clustered in the 15- to 25-day range, and we have therefore chosen 20 and 25 days for our medium and high estimates.

Average charge per hospital day. Average charges per hospital day ranged from \$471 to \$1,038. Evaluating the data in table 7, we chose \$850 and \$950 as reasonable figures for our medium and high estimates because the charges were clustered in the \$800-\$1,000 range.

Average outpatient charges. Data on outpatient charges are practically nonexistent. In addition to our data from SFGH, the study by Seage and co-workers (table 7, item 19; outpatient charges not shown in table) put outpatient costs at \$2,668.

The California AIDS study estimated outpatient costs at 10 percent of total costs (table 7, item 1; charges not shown in table). In the absence of more data, we used our estimated outpatient charge of \$4,000 (derived from our SFGH data but roughly doubled as described perviously) for our low estimate and decreased the amount in the higher estimates on the assumption that patients with longer hospital stays receive less outpatient care.

Estimates of the Nonpersonal Costs

The spread of the AIDS epidemic has led to the development by the public and private sectors of a variety of nonpersonal services which must be included as part of the direct costs of AIDS. These services include research, conducted mainly by the Federal and State Governments; blood screening services which include screening of blood donors, commercial plasma donors, high-risk groups, sexual contacts of high-risk groups, aliens seeking admission to the United States and, more recently, members of and recruit applicants to the U.S. military service; and finally a variety of support services provided by local governments and community-based organizations. Included in these support services are counseling; emotional and spiritual care for patients, their families, and friends; housing; and help with shopping and transportation.

Like the data on personal health care use and expenditures of persons with AIDS, data on nonpersonal costs are difficult to obtain and even more difficult to project. For example, while expenditures for research by the Federal Government are available from the Federal budget, State expenditures for research are more problematical because they are frequently included with other budget items. In the case of many services, much depends on the assumptions one makes regarding the number of specific services rendered in a year (for example, the number of blood samples tested) and of the cost per service. The cost of the ELISA blood screening test is estimated in the range of \$5 to \$10, that of the Western blot test in the range of \$40 to \$50. Finally, for education, information, and miscellaneous support services, data on expenditures are frequently combined with expenditures for blood screening and medical care.

In view of these many uncertainties, low and medium-high estimates were made for each of the groups of nonpersonal costs of AIDS for 1985 and 1986. Estimates for the more distant future are

Table 6. Estimated personal medical care costs of AIDS in 1985, 1986, and 1991 in 1984 dollars

Estimates	1985	1986	1991
Number of AIDS cases.....	18,720	31,440	172,800
	<i>Expenditures in millions</i>		
Low.....	\$381	\$640	\$3,517
Medium.....	597	1,003	5,512
High.....	1,016	1,706	9,374

practically impossible because so many factors affect expenditures for these services and because these factors are likely to change over time. For 1991, we therefore assumed that expenditures for nonpersonal services would equal about 27 percent of personal medical care expenditures, approximately the same as their percentage in our high estimate for 1986, and we made three estimates ranging from low to high. Table 8 shows our estimates of nonpersonal costs of AIDS in 1984 dollars and in current dollars. In 1984 dollars, the estimated totals range from \$232 million to \$303 million in 1985 and from \$405 million to \$486 million in 1986. In 1991, the estimates range from a low of \$900 million to a high of \$2.5 billion.

Estimates of the Indirect Costs

Indirect costs are the value of lost output because of cessation or reduction of productivity caused by morbidity and mortality. Morbidity costs are wages lost by people who are unable to work because of illness and disability; for persons too sick to perform their usual housekeeping services an imputed value of these services is included. Mortality costs are the present value of future earnings lost by people who die prematurely.

To estimate the indirect costs of AIDS, the human capital method as developed by Rice was used (8-10). It is called the human capital method because an employed person is seen as producing a stream of output over the years that is valued at the individual's earnings.

Morbidity costs. Calculating morbidity costs involves applying average earnings by age and sex to work-loss years for those currently employed, attaching a dollar value to housekeeping services for those unable to perform these services because of illness, and applying labor force participation

Table 7. Data on average length of hospital stay, average charge per hospital day, and average number of admissions of AIDS patients

Source	Average length of hospital stay (days)	Average charge per hospital day (dollars)	Average number of admissions per patient ¹
<i>California</i>			
1. Kizer, K., Rodrigues, J., McHolland, G. F., and Weller, W.: "A Quantitative Analysis of AIDS in California." CA Department of Health Services, Sacramento, March 1986:			
California	14.0	² \$606, \$892	6.4
Los Angeles County	17.9	686, 1,038	5.6
San Francisco	12.1	552, 735	6.7
Other California counties	14.2	598, 991	6.7
			} over an 18-month period
2. West Bay Hospital Conference, San Mateo. AIDS Inpatient Hospital Utilization. San Francisco, July 10, 1986. First quarter, 1986 .	10.8	...	...
3. West Bay Hospital Conference, San Mateo. AIDS Inpatient Hospital Utilization. San Francisco, Jan.-Dec. 1985. Apr. 3, 1986 (1,862 discharges)	11.9	...	...
4. West Bay Hospital Conference, San Mateo. AIDS Inpatient Hospital Utilization. West Bay and San Francisco hospitals, 1984. Oct. 1985:			
1984 (1,134 discharges, 665 cases)	12.3	918	1.7
1983 (230 discharges)	13.9	...	...
1982 (19 discharges)	18.2	...	...
5. West Bay Hospital Conference, San Mateo. AIDS Inpatient Hospital Utilization. West Bay and San Francisco hospitals, 1982-83. June 1985 (202 cases)	13.0	876	...
6. Hospital Council of Southern California, Los Angeles. AIDS Status Report, Hospital Services in Southern California, Oct. 1985. (976 hospitalizations-110 hospitals reporting on most recent 12-month period. 48 hospitals provided information on charges)	17.3	963	...
<i>New York</i>			
7. State Department of Health, Albany. AIDS reports from New York City. Memorandum to S. Anderman, Dec. 10, 1985:			
1,573 admissions, 1984	18.2	575	...
No intensive care unit use	17.2	518	...
Intensive care unit use (only 8.4 percent had it)	29.1	1,000	...
Drug cases	17.4	587	...
Nondrug cases	18.0	573	...
8. Passman, L. J., AIDS Inpatients: Case Mix and Cost Variation. N.Y. University Medical Center, 1983 (116 cases)	19.5	...	1.6
9. Leicht, D., New York City Health and Hospitals Corporation. Statement before the Labor, Health and Human Services, Education and Related Agencies Subcommittee, U.S. Senate Appropriations Committee, Sept. 26, 1985 .....	...	749-850	...
10. Sencer, D. J., and Botnick, V. E., Report to the Mayor, New York City's Response to the AIDS Crisis, Dec. 1985 (HHC hospitals, mid-1985)	25.4	800	...
11. Fox, D., NY State Center for Assessing Health Services, State University of New York at Stony Brook (23 cases, University Hospital, Stony Brook, 1984)	25	940	...
12. Belmont, M. F., St. Luke's-Roosevelt Hospital Center Study, Resource Utilization by AIDS Patients in the Acute Care Hospital, Dec. 1985 (152 cases, Jan. 1984-Apr. 1985)	22	...	2 over unspecified period
13. Draft table prepared by State Department of Health, Office of Systems Management, Albany (1981-84, excludes diagnosis of Kaposi's sarcoma):			
New York State (3,158 cases)	27.0	...	...
New York City (2,869 cases)	26.5	...	...

Table 7. Data on average length of hospital stay, average charge per hospital day, and average number of admissions of AIDS patients—Continued

Source	Average length of hospital stay (days)	Average charge per hospital day (dollars)	Average number of admissions per patient ¹
<i>Florida</i>			
14. Data from Reynolds, S. P., University of Miami-Jackson Memorial Medical Center, Miami	21	858	3.2 over 2-year period
<i>Michigan</i>			
15. Preliminary Report—Michigan Medicaid Expenditures Related to AIDS. Data from J. F. Groen, State Department of Social Services, Lansing (10 cases, 1981–84)	20.1	³ 805,572	4.2 over an average of 22.6 months (2.3 per year) ⁴
<i>Minnesota</i>			
16. Data from J. Shultz, State Department of Health, Minneapolis (24 cases, University of Minnesota Hospital, Jan. 1981–Dec. 1985)	12.3	917	3.4 over unspecified period
<i>New Jersey</i>			
17. Baxter, R. C., and Ksell, T. E.: Needs Assessment, Acquired Immune Deficiency Syndrome, Apr. 1985. State Department of Health, Division of Epidemiology, AIDS Activity, Trenton (46 cases)	52	...	3 over unspecified period
<i>Texas</i>			
18. Data from D. Gibson, State Department of Health, Austin, from Survey of Hospital Cost for AIDS Patients, State of Texas, Jan. 1985 (5 cases, Houston)	72.2	471	...
<i>Massachusetts</i>			
19. Seage, G. R., III, et al.: "Medical Costs of Patients with Acquired Immunodeficiency Syndrome (AIDS) and AIDS Related Complex (ARC)." JAMA. In press. (45 cases, New England Deaconess Hospital, Boston, Mar. 1984–Feb. 1985)	21.3	808 (687 cost)	1.6 (3.3 per year)
<i>Other</i>			
20. Data from N.W. Axnick, Centers for Disease Control, Atlanta, GA., Feb. 27, 1986:			
20 cases, Chicago, IL	18.8	...	...
20 cases, Newark, NJ	20.5	...	...
18 cases, Philadelphia, PA	29.7	...	...
20 cases, Houston, TX	15.0	...	...
20 cases, Washington, DC	16.0	...	...

¹Number of admissions per patient is the number of admissions over the course of the year divided by the total number of patients alive at any time during the year. Number of admissions per patient per year is the total number of admissions divided by the number of months the patients were covered by a study times 12. If the time during which patients were included in a study was not specified, this is indicated in the table.

²Lower number is MediCal payment; higher number refers to billed charges.
³Medicaid payment.

⁴Our estimate based on these data.

NOTE: All studies and memoranda mentioned in this table are unpublished except for those in items 1 and 19.

rates and earnings to persons who are too sick to be employed. For morbidity costs, the groups of AIDS patients who lived all 12 months and those who were newly diagnosed and alive at the end of the year were combined, and a 60 percent disability rate was applied on the assumption that these patients were, on the average, too ill to work 60 percent of the time. The number of deaths were divided in half on the assumption that they occurred evenly during the year, and it was

assumed that these patients were too ill to work at all prior to their death.

There are no hard data on the earnings of persons with AIDS. There is some evidence that male homosexuals have above-average earnings. However, the majority of AIDS victims who are intravenous (IV) drug abusers probably have little or no income or income from illegal sources (drug dealing, theft, and prostitution). In the absence of good data, it was assumed that persons with AIDS

Table 8. Estimated nonpersonal costs of AIDS in 1984 and current dollars, 1985, 1986, and 1991¹

Type of expenditures	1985		1986		1991		
	Low	Medium-high	Low	Medium-high	Low	Medium	High
<i>Millions of 1984 dollars</i>							
Total	\$232	\$303	\$405	\$486	\$900	\$1,500	\$2,500
Research ²	108	108	209	209	450	750	1,250
Blood screening and replacement	106	173	171	248	360	600	1,000
Health education, information, and support services ³	18	22	25	28	90	150	250
<i>Millions of current dollars</i>							
Total	\$245	\$319	\$452	\$542	\$1,395	\$2,325	\$3,875
Research ²	114	114	234	234	698	1,163	1,938
Blood screening and replacement	112	182	191	277	558	930	1,550
Health education, information, and support services ³	19	23	28	32	140	233	388

¹Reference 3 for 1985 and 1986; 1991 figures estimated at about 27 percent of medical costs in 1984 dollars.

²Includes Federal and State budgeted or obligated amounts.

³Includes expenditures by the CDC, State and local governments, and community-based volunteer organizations.

had the same average earnings as all others in their age and sex group. Because 1984 data on earnings by age and sex were not available, the 1983 figures were adjusted by a factor of 1.048, the ratio of gross average weekly earnings in 1984 to those in 1983. It was also assumed that labor force participation rates of persons with AIDS were the same as those of all others in their age and sex group.

On the basis of these assumptions, morbidity costs in 1984 dollars were estimated at \$251 million in 1985, \$421 million in 1986, and \$2.3 billion in 1991. These estimates are shown in table 9.

Mortality costs. The estimated cost or value to society of premature deaths is the product of the number of deaths and the expected value of a person's future earnings with sex and age taken into account. This method of derivation takes into consideration life expectancy for different age and sex groups, varying labor force participation rates, changing patterns of earnings at successive ages, imputed value for housekeeping services, and the appropriate discount rate to convert a stream of costs or benefits into its present worth. As in the estimates of morbidity costs, it was assumed that persons with AIDS had the same earnings and labor force participation rates as the population as a whole according to their age and sex group. Because the selection of the discount rate makes a considerable difference in discounting future earnings, two estimates were made, a higher one using a 4 percent and a lower one using a 6 percent discount rate. The present values of lifetime earnings in 1984 by age and sex and the two discount rates are shown in table 10.

As table 9 shows, mortality costs are estimated at \$2.8 billion (6 percent discount rate) and \$3.5 billion (4 percent discount rate) in 1985. For 1986, mortality costs are estimated at \$4.8 billion and \$6.0 billion at 6 percent and 4 percent discount rates, respectively. For 1991, estimated mortality costs are \$28.6 billion and \$36.3 billion with the 6 percent and 4 percent discount rates, respectively.

Comparison with Other Health Care Costs

In conclusion, to give our estimates some perspective, they must be set within the framework of other health care cost data. To begin with the personal medical care costs of AIDS patients, shown in table 2 (in current dollars), our best estimate of \$630 million in 1985 represents 0.2 percent of 1985 personal health care expenditures in the United States as estimated by the Health Care Financing Administration. Our best estimates of these expenditures in 1991, \$8.5 billion, represent 1.4 percent of estimated 1991 personal health care expenditures.

We can also compare our estimates of medical care expenditures of AIDS patients in 1985 with expenditures of patients suffering from other diseases. In 1980, the Medicare Program paid \$1.3 billion in reimbursements for patients with end-stage renal disease (11); in terms of 1985 expenditures, this sum would amount to about \$2.2 billion. Persons injured in automobile accidents are estimated to have incurred medical costs of \$3.3 billion in 1980 (U.S. Department of Transportation, National Highway Traffic Safety Administration: The economic cost to society of motor

Table 9. Estimated economic costs of AIDS by type of cost and range of estimates, 1985, 1986, and 1991 (millions of 1984 dollars)

Estimates	Total direct and indirect costs	Direct costs			Indirect costs		
		Total	Personal medical care costs	Non-personal costs	Total	Morbidity	Mortality ¹
1985							
Low	\$3,618	\$613	\$381	\$232	\$3,004	\$251	\$2,753
Medium	4,645	900	597	303	3,745	251	3,494
High	5,063	1,318	1,016	303	3,745	251	3,494
1986							
Low	6,231	1,045	640	405	5,186	421	4,765
Medium	7,957	1,489	1,003	486	6,468	421	6,047
High	8,659	2,192	1,706	486	6,468	421	6,047
1991							
Low	35,307	4,417	3,517	900	30,891	2,301	28,590
Medium	45,594	7,012	5,512	1,500	38,582	2,301	36,281
High	50,456	11,874	9,374	2,500	38,582	2,301	36,281

¹Low mortality costs are discounted at 6 percent; medium and high costs are discounted at 4 percent.

vehicle accidents. Unpublished report DOT HS 806 342. January 1983). In terms of 1985 expenditures, this would amount to about \$5.6 billion. Finally, it has been estimated that in 1980 the medical costs of persons with cancer of the digestive system amounted to \$2.0 billion; those of persons with cancer of the lung, trachea, and bronchus to \$1.6 billion; and those with cancer of the breast to \$1.3 billion (personal communication, Thomas A. Hodgson, PhD, Chief Economist, Office of Analysis and Epidemiology, National Center for Health Statistics). In terms of 1985 expenses, these figures translate into \$3.4 billion, \$2.7 billion, and \$2.2 billion, respectively. It must be borne in mind, however, that with the exception of patients with end-stage renal disease, where Medicare data indicate that annual medical care costs *per patient* are as high or even higher than those of persons with AIDS, costs *per patient* with most other conditions are likely to be considerably lower than those of persons with AIDS.

Extrapolating 1980 medical expenditures for specific diseases to 1991 is very problematic. But if we assume that the prevalence of and relative medical expenditures for these conditions remain unchanged over time, only medical expenses of victims of automobile accidents will exceed the medical care costs of AIDS patients in 1991, and expenditures of patients with the other conditions will range from about 45 to 70 percent of those of AIDS patients.

Our best estimates of the indirect costs of AIDS in the United States in current dollars—\$3.9 billion in 1985 and \$7.0 billion in 1986—represent 1.2 percent and 2.1 percent of the estimated total

Table 10. Present value of lifetime earnings, by age, sex, and discount rate: 1984

Age group (years)	Males		Females	
	4 percent	6 percent	4 percent	6 percent
0-1	\$499,443	\$238,539	\$412,023	\$206,236
1-4	525,987	263,469	433,649	227,648
5-9	575,104	313,854	473,893	271,039
10-14	634,575	380,914	522,698	328,825
15-19	692,709	454,056	561,108	383,029
20-24	730,367	514,486	565,770	409,238
25-29	727,092	540,851	532,954	401,043
30-34	684,000	531,320	476,460	369,506
35-39	611,477	493,619	410,138	326,869
40-44	513,890	429,242	341,275	279,445
45-49	404,630	349,046	273,678	230,549
50-54	291,340	259,304	204,908	177,291
55-59	178,982	163,627	138,331	122,232
60-64	83,666	77,741	82,605	74,060
65-69	30,453	27,984	44,956	40,582
70-74	14,905	13,813	24,691	22,602
75-79	7,225	6,759	12,525	11,628
80 and older	2,321	2,215	3,765	3,576

SOURCE: Reference 3.

indirect costs of all illness in these 2 years; by 1991, however, they are estimated to represent close to 12 percent of the estimated total indirect costs of all illness. Our estimates of the indirect costs of all illness in 1985, 1986, and 1991 are based on estimates by Rice and co-workers (10) and assume that the costs increase at the annual average rate of increase in average earnings supplied by the Office of the Actuary of the Social Security Administration.

To sum up, the annual costs—both direct and indirect—of the AIDS epidemic to date have been

relatively low when compared with the economic costs of all illness as well as the costs of some other diseases. These comparisons are in no way intended to belittle the burden that the epidemic imposes on its victims and society in general. Moreover, what has aggravated the situation is that AIDS cases have been concentrated in a few metropolitan centers, which has put and continues to put a serious strain on the resources of these centers, especially on their public hospitals. If the epidemic spreads as forecast by the CDC, however, its burden will be very heavy and will be felt throughout the nation. Thus it is clear that combating the AIDS epidemic requires efforts and financial resources at all levels of the private and public sectors: efforts to reduce the medical care costs by providing alternatives to hospital care; education and information to prevent the spread of the disease, especially for IV drug abusers, since there is considerable evidence that educational efforts aimed at homosexual males have been highly effective; and finally funds for further research to develop a vaccine or a cure for AIDS.

Limitations of the Estimates

It must be stressed that our estimates have a number of limitations.

- **The CDC prevalence estimates.** Uncertainty about the future course of the AIDS epidemic makes forecasts extremely difficult, especially for later years such as 1991. Since the CDC constantly updates its estimates by using the latest information on the progress of the disease, the figures used in our estimates may be superseded in a relatively short time.

- **Our assumption (suggested by Morgan of the CDC) that the distribution of AIDS cases among diagnostic groups stays the same as in 1984.** This premise is probably unrealistic. According to Morgan, it is possible that in 1991, only 10 percent of all cases, as against almost 20 percent in 1984, may suffer from Kaposi's sarcoma. Because patients with Kaposi's sarcoma are less expensive to treat than those with *Pneumocystis carinii* pneumonia and other infectious diseases, we have estimated that this would raise direct personal medical care costs by between 4 and 5 percent.

- **Our assumption that the average months of life in 1984 of AIDS patients who died and of those newly diagnosed and alive at the end of the**

year was the same for all U.S. patients as for the SFGH patients and that these averages stay the same over time. Given mortality rates of AIDS cases and the increase in the incidence of AIDS in recent years, our figures seem reasonable for 1985 and 1986 (that is, about 6 months of expenses for those who died and not quite 5 months for those newly diagnosed who were alive at the end of the year), but they can change, and are likely to change, over time.

- **Our assumption that medical treatment of AIDS patients remains unchanged.** This assumption is clearly unrealistic. We know that, in the course of the epidemic to date, changes in treatment have already occurred. There is considerable evidence that the average length of hospital stay has declined. For example, data in table 7 show that the average stay of AIDS patients in San Francisco bay area hospitals declined from 18.2 days in 1982 to 12.3 days in 1984. In San Francisco hospitals, average hospital stay declined steadily from 13.1 days in the first quarter of 1985 to 10.8 days in the first quarter of 1986. At M. D. Anderson Medical Center in Houston, TX, the average hospital stay is reported to have gone from 30 days in the early days of the epidemic to 15 days in early 1986. There is also anecdotal evidence that the use of intensive care units for AIDS patients has declined, mainly because it was found that in many cases treatment in an ICU prolonged dying rather than living. Another example is the current practice at SFGH to administer most blood transfusions to severely anemic AIDS patients on an outpatient rather than an inpatient basis, as had been the custom in the earlier years of the epidemic. The effect on medical care costs of a new drug, such as the recently introduced drug AZT, is still unclear. It appears to prolong the life expectancy of the AIDS patients who respond favorably to it, but it also requires considerable medical monitoring in the form of physician and laboratory services, which may well increase costs. On the other hand, if it reduces the severity of acute episodes of illness and the use of hospital services, it may lower costs despite the monitoring costs and the patients' longer life expectancy.

There is little question that further changes will occur in the next few years. Numerous drugs are currently being tested in the laboratory, and others will most likely be developed. Last but not least, if an effective cure or a vaccine is found, the entire cost situation—direct and indirect costs—will change completely.

• **Our assumptions underlying the estimates of direct nonpersonal costs.** Expenditures for research in 1991 are uncertain; they will depend on progress in research to treat AIDS patients and to develop a vaccine. Other nonpersonal direct costs of AIDS, especially health education, information, and support services, depend on the future community response to the AIDS epidemic.

• **Our assumption that wage patterns by age and sex remain the same over time.** This too is an unrealistic assumption, considering the changes that the American economy has been undergoing from a manufacturing to a service economy and the growing number of women in the labor force. However, in the absence of good data for an alternative assumption, we have assumed unchanged wage patterns.

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The Prevention and Control of Chronic Diseases: Reducing Unnecessary Deaths and Disability—A Conference Report

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Synopsis.....

Effective, yet underused, preventive measures exist to ameliorate such important public health

problems as hypertension, coronary artery disease, and cervical cancer. The First National Conference on Chronic Disease Prevention and Control was convened in September 1986 by the Association of State and Territorial Health Officials and the Centers for Disease Control, Public Health Service, to disseminate information on successful chronic disease programs currently being implemented and to identify barriers to more widespread application of state-of-the-art prevention technology. This report briefly summarizes the deliberations of conference working groups (composed primarily of State and Federal public health officials) that addressed these issues. Numerous suggestions for improved surveillance, applied research, and training related to chronic disease prevention and control were offered, as well as ideas on organizing and marketing chronic disease intervention programs. The conference clearly identified a pressing need for a coalition of public health agencies and interested professional and voluntary organizations, as well as a coherent national agenda to combat chronic diseases.